

IN THE CLAIMS:

Please note that all claims currently pending and under consideration in the referenced application are shown below, in clean form, for clarity.

51
ES
1. (Twice Amended) A pickup tool for placing preformed solder balls on a substrate, comprising:
a tool body controllably movable in multiple axes and rotatable about an axis;
a plurality of ball seats formed in said body for said preformed solder balls, said plurality of ball seats each having an aperture therein;
passageways leading from said aperture to a vacuum source and to a pressurized gas source;
a first valve apparatus for controlling separately and independently a vacuum to said ball seats, said vacuum retaining said solder balls on said ball seats; and
a second valve apparatus for controlling separately and independently a gas under pressure to said ball seats, said gas under pressure for releasing said solder balls from said ball seats.

2. The pickup tool of claim 1, wherein said vacuum holds said solder balls in said ball seats and said pressurized gas ejects said solder balls from said ball seats.

3. The pickup tool of claim 1, wherein said vacuum holds said solder balls in said ball seats and said pressurized gas ejects said solder balls from said ball seats to a plurality of bond pads on said substrate.

4. The pickup tool of claim 1, further comprising:
a controllable ball dispenser supplying solder balls to said pickup tool, comprising:
a ramp for feeding solder balls to said ball seats, said ramp having an upper end and a lower end;
a controllable valve at the lower end of said ramp for releasing a single solder ball of said solder

balls on demand to said ball seats using a vacuum applied to said ball seats; and
a reservoir providing a supply of solder balls to said ramp.

5. The pickup tool of claim 4, further comprising:
a gas inlet in said reservoir, said gas inlet connected to a source of pressurized gas for providing
gas flow through said solder balls to provide a non-interrupted flow of said solder balls
through said ramp.

6. The pickup tool of claim 4, wherein said ramp holds a series of solder balls having
a diameter in the range of about 0.01 mm to about 0.15 mm.

c2 7. ~~8.~~ (Twice Amended) A pickup tool for placing a plurality of solder balls on ball-
grid-array bond pads of a substrate, said pickup tool comprising:
a pickup tool body with a hollow chamber therein;
a lower plate having a plurality of seats therein for retaining a solder ball in each seat, said
plurality of seats corresponding to an inverted configuration of an array of bond pads on a
substrate;
a plurality of passageways leading from each said seat to said hollow chamber;
a passageway leading from said chamber to a vacuum source;
a passageway leading from said chamber to a pressurized gas;
a first controllable valve apparatus for controlling opening and closing said vacuum passageway;
and
D a second controllable valve apparatus for controlling opening ^{and} closing said pressurized gas
passageway.

9. (Previously Amended) The pickup tool of claim 8, further comprising:
a heater to heat said pickup tool to a temperature to bond said solder balls to said bond pads of
said substrate.

C3 9 10. (Twice Amended) A pickup tool for placing preformed solder balls on a
substrate, comprising:
a tool body controllably movable in multiple axes and rotatable about an axis;
a plurality of ball seats formed in said tool body for a plurality of solder balls, each ball seat of
said plurality of ball seats having an aperture therein;
passageways leading from said aperture to a vacuum source and to a pressurized gas;
a first controllable valve apparatus controlling the vacuum, said vacuum retaining said solder ball
in each said ball seat; and
a second controllable valve apparatus controlling the pressurized gas to said ball seat, said
pressurized gas for releasing said solder ball from said ball seat.

11. The pickup tool of claim 10, wherein said vacuum holds said solder ball in said
ball seat and said pressurized gas ejects said solder ball from said ball seat to a bond pad on a
substrate.

C4 11 12. (Amended) A pickup tool for placing preformed solder balls on a substrate,
comprising:
a tool body controllably movable in multiple axes and rotatable about an axis;
a plurality of ball seats formed in said tool body for a plurality of solder balls, each ball seat of
said plurality of ball seats having an aperture therein;
passageways leading from said aperture to a vacuum source and to a pressurized gas; and

C4
E7
and

controllable valve apparatus controlling the vacuum and the pressurized gas to said ball seat, said vacuum retaining said solder ball in each said ball seat and said pressurized gas releasing said solder ball from said ball seat;

a solder ball dispenser supplying solder balls to said pickup tool, comprising:

a tubular ramp for feeding solder balls to said ball seat, said ramp having an upper end and a lower end;

a controllable valve at the lower end of said ramp for releasing a single solder ball to said ball seat while a vacuum is applied to said ball seat;

a reservoir for providing a supply of solder balls to move downwardly through said ramp.

13. The pickup tool of claim 12, further comprising:

a gas inlet in said reservoir, said gas inlet connected to said pressurized gas providing gas flow through said solder balls providing a non-interrupted flow of solder balls through said ramp.

14. The pickup tool of claim 12, wherein said ramp holds solder balls having a diameter of about 0.01 mm to about 0.15 mm.

C5
14

15. (Twice Amended) A pickup tool for placing a plurality of solder balls on ball-grid-array bond pads of a substrate, said pickup tool comprising:

a pickup tool body with a hollow chamber therein;

a lower plate having a plurality of seats therein for attracting and retaining a solder ball in each seat, said plurality of seats corresponding to an inverted array of bond pads on a substrate;

passageways leading from each said seat of said plurality of seats to said hollow chamber;

a passageway leading from said chamber to a vacuum source;

a passageway leading from said chamber to a pressurized gas;

a first controllable valve apparatus for controlling opening and closing said vacuum passageway;

and

CS
a second controllable valve apparatus for controlling opening and closing said pressurized gas passageway.

16. The pickup tool of claim 15, further comprising:
a heater to heat said solder balls to a temperature to bond to said bond pads on said substrate.